Soil moisture estimation in hydrological mesoscale modelling using ERS SAR data

Herrmann-Gregor Mendel
Felix Portmann

Federal Institute of Hydrology
Kaiserin-Augusta-Anlagen 15-17
D-56072 Koblenz, F.R.G.
Phone: +49 261 1306-217 / -218
Fax: +49 261 1306-280

Abstract
The moisture in the top soil layer is considered as a key element in the runoff process. Facilitation and improvements of the computation of runoff, particularly in flood events, and water balance is readily acknowledged if this value were known for the whole catchment or at least for representative sub-areas. Direct measurements on the ground at all sites are impossible because of the unjustifiable expenditures, and indirect estimates are inacceptable because of their high degree of uncertainty. Remote sensing from satellite, especially radar satellites like ERS, being indedepdent from weather conditions, is expected to offer an alternative. Therefore, the derivation of soil moisture from satellite synthetic aperture radar (SAR) data is expected to be a key element in a state-of-the-art runoff process modelling. Yet, the derivation of the volumetric soil moisture is, up to now, readily available to a certain extent only for bare soil. The framework conditions, e.g. inclination of the terrain, surface texture / roughness, flooding of an area increase the incertainty in the respective derivative function. Ground-truth information is needed for the calibration of that function. For a flat area in Northern Germany, a relationship for bare soil conditions between the backscattering coefficient sigma zero and volumetric soil moisture could be established, resulting in an R squared of 0.7 without outliers. Outlying values have to be discussed individually with respect to derivation due to soil probing accuracy, vegetation cover/texture, specular reflection. Their inclusion significantly reduces the goodness of fit to an R squared of 0.3.